MEASUREMENT REPORT

FCC PART 15.247 / RSS-247 ZigBee 802.15.4

FCC ID	:	2ACS5-ST10C
IC	:	11554B-ST10C
APPLICANT	:	Yuneec Technology Co., Limited

Application Type	:	Certification
Product	:	Personal Ground Station
Model No.	:	ST10C
Brand Name	:	YUNEEC
FCC Classification	:	Digital Transmission System (DTS)
FCC Rule Part(s)	:	Part 15 Subpart C (Section 15.247)
IC Rule(s)	:	RSS-247 Issue 2, RSS-GEN Issue 4
Test Procedure(s)	:	ANSI C63.10-2013, KDB 558074 D01v04
Test Date	:	November 09 ~ 22, 2017

Reviewed By : Paddy Chen
(Paddy Chen)

Approved By : Chenz Ker
(Chenz Ker)

Testing Laboratory
3261

The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB 558074 D01v04. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Taiwan) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date	Note
1711TW0140-U1	Rev. 01	Initial report	12-12-2017	Valid

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§2.1033 General Information

Applicant:	Yuneec Technology Co., Limited
Applicant Address:	Unit 2301, 23/F, 9 Chong Yip Street, Kwun Tong, Kowloon, Hong Kong
Manufacturer:	Yuneec International (China) Co., Ltd.
Manufacturer Address:	No.388 East Zhengwei Road, Jinxi Town, Kunshan, Jiangsu 215324, China
Test Site:	MRT Technology (Taiwan) Co., Ltd
Test Site Address:	No. 38, Fuxing Second Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C)
FCC Registration No.:	153292
IC Registration No.:	21723
Test Device Serial No.:	N/A ☐ Production ☒ Pre-Production ☐ Engineering
FCC Classification:	Digital Transmission System (DTS)

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Fuxing Rd., Taoyuan, Taiwan (R.O.C)

- **MRT facility is a FCC registered (Reg. No. 153292) test facility with the site description report on file and is designated by the FCC as an Accredited Test Film.**
- **MRT facility is an IC registered (MRT Reg. No. 21723-1) test laboratory with the site description on file at Industry Canada.**
- **MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (TAF) under the American Association for Laboratory Accreditation Program (TAF Cert. No. 3261) in EMC, Telecommunications and Radio testing for FCC, Industry Taiwan, EU and TELEC Rules.**

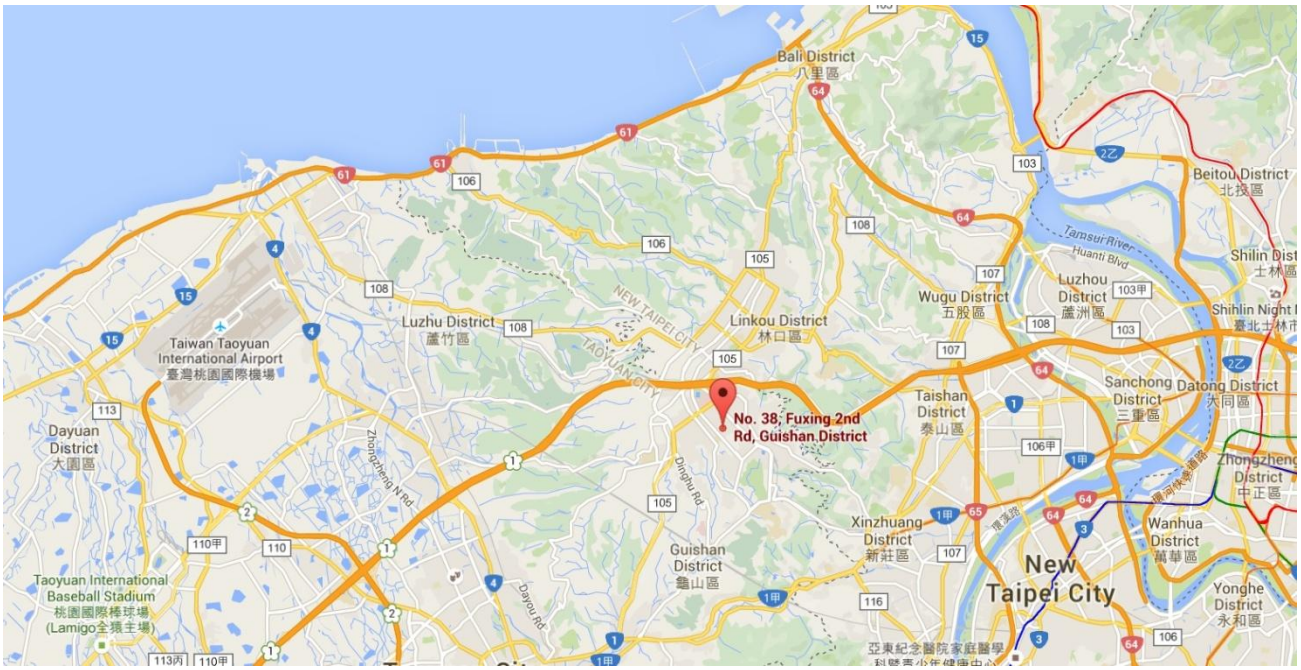
1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taoyuan City. These measurement tests were conducted at the MRT Technology (Taiwan) Co., Ltd. Facility located at No.38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 33377, Taiwan (R.O.C).



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name	Personal Ground Station
Model No.	ST10C
Brand Name	YUNEEC
Wi-Fi Specification	802.11a/n-HT20
ZigBee Specification	802.15.4

2.2. Product Specification Subjective to this Report

Frequency Range	802.15.4: 2405 ~ 2475 MHz
Maximum Peak Output Power	17.96dBm
Type of Modulation	O-QPSK
Operating Mode	1*TX and 1*RX

Note: For other features of this EUT, test report will be issued separately.

2.3. Operation Frequency / Channel List

Channel	Frequency	Channel	Frequency	Channel	Frequency
11	2405 MHz	12	2410 MHz	13	2415 MHz
14	2420 MHz	15	2425 MHz	16	2430 MHz
17	2435 MHz	18	2440 MHz	19	2445 MHz
20	2450 MHz	21	2455 MHz	22	2460 MHz
23	2465 MHz	24	2470 MHz	25	2475 MHz

2.4. Description of Available Antennas

Antenna Type	Manufacturer	Frequency Band (MHz)	Max Peak Gain (dBi)
PCB Antenna	Yuneec Technology Co., Limited	2400 ~ 2483.5	1.22
Omni-directional Antenna		5150 ~ 5250	4.08
		5725 ~ 5850	1.08

2.5. Test Mode

Test Mode	Mode 1: Transmit by 802.15.4

2.6. Test Software

The test utility software used during testing was engineering directive ordered by applicant.

2.7. Device Capabilities

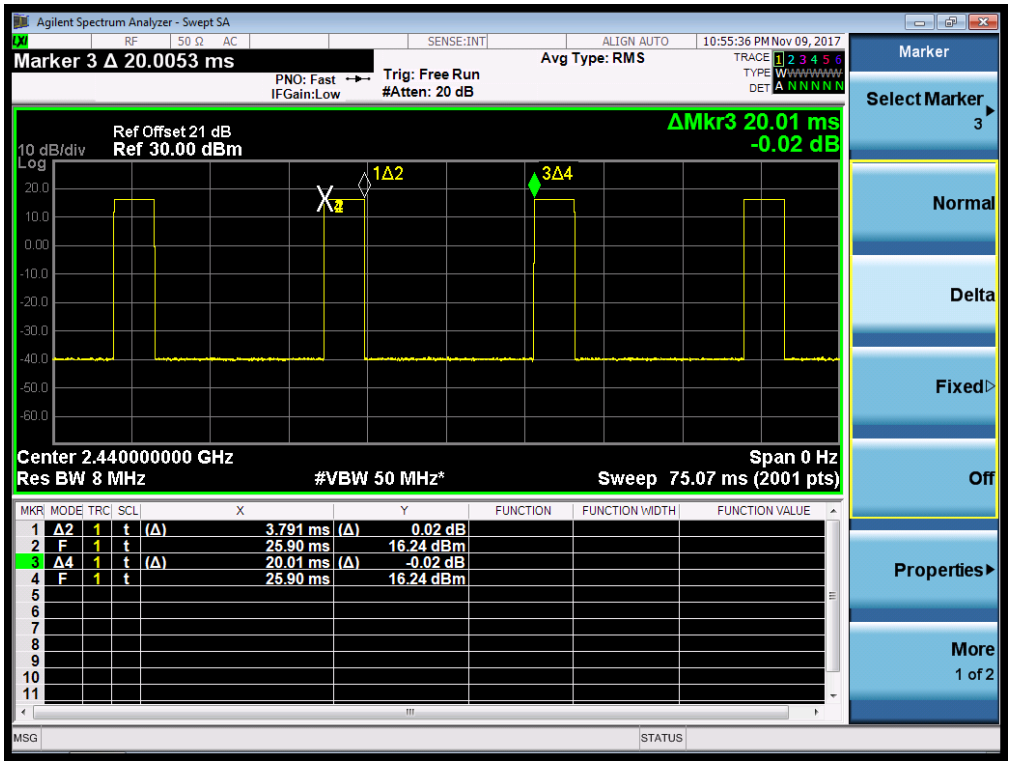
This device contains the following capabilities:

2.4GHz ZigBee (DTS), 5.8GHz WLAN (UNII)

Note: 2.4GHz ZigBee (DTS) operation is possible in 20MHz channel bandwidth. The maximum achievable duty cycle was determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Test Mode	Duty Cycle
802.15.4	18.95%

802.15.4 - T = 3.791 ms



2.8. Test Configuration

The **Personal Ground Station FCC ID: 2ACS5-ST10C** was tested per the guidance of KDB 558074 D01v04. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

2.9. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.10. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

3. DESCRIPTION OF TEST

3.1. Evaluation Procedure

The measurement procedures described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013), and the guidance provided in KDB 558074 D01v04 were used in the measurement of the **Personal Ground Station FCC ID: 2ACS5-ST10C.**

Deviation from measurement procedure…….....None

3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an 8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150kHz to 30MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or data exchange speed, or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions are used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

An extension cord was used to connect to a single LISN which powered by EUT. The extension cord was calibrated with LISN, the impedance and insertion loss are compliance with the requirements as stated in ANSI C63.10-2013.

3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. A MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm high PVC support structure is placed on top of the turntable.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-25GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions. According to 3dB Beam-Width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

4. ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antenna of the **Personal Ground Station** is **permanently attached.**
- There are no provisions for connection to an external antenna.

Conclusion:

The **Personal Ground Station FCC ID: 2ACS5-ST10C** unit complies with the requirement of §15.203.

5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions - SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR3	MRTTWA00045	1 year	2018/03/17
Two-Line V-Network	R&S	ENV216	MRTTWA00019	1 year	2018/03/23
Two-Line V-Network	R&S	ENV216	MRTTWA00020	1 year	2018/03/23
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2018/06/08

Radiated Emissions - AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Signal Analyzer	R&S	FSV40	MRTTWA00007	1 year	2018/03/02
EMI Test Receiver	R&S	ESR3	MRTTWA00009	1 year	2018/03/16
Broadband Preamplifier	SCHWARZBECK	BBV 9718	MRTTWA00005	1 year	2018/04/06
Broadband Amplifier	SCHWARZBECK	BBV 9721	MRTTWA00006	1 year	2018/04/06
Acitve Loop Antenna	SCHWARZBECK	FMZB 1519B	MRTTWA00002	1 year	2018/04/06
Broadband TRILOG Antenna	SCHWARZBECK	VULB 9162	MRTTWA00001	1 year	2018/04/06
Broadband Hornantenna	SCHWARZBECK	BBHA 9120D	MRTTWA00003	1 year	2018/04/06
Breitband Hornantenna	SCHWARZBECK	BBHA 9170	MRTTWA00004	1 year	2018/04/06
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2018/06/08

Conducted Test Equipment - SR1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EXA Signal Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2018/07/10
X-Series USB Peak and Average Power Sensor	KEYSIGHT	U2021XA	MRTTWA00014	1 year	2018/03/18
X-Series USB Peak and Average Power Sensor	KEYSIGHT	U2021XA	MRTTWA00015	1 year	2018/03/18
Programmable Temperature & Humidity Chamber	TEN BILLION	TTH-B3UP	MRTTWA00036	1 year	2018/05/11
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2018/06/08

Software	Version	Function
e3	V8.3.5	EMI Test Software

6. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2.

AC Conducted Emission Measurement - SR2
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 150kHz~30MHz: 3.46dB
Radiated Emission Measurement - AC1
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 9kHz ~ 1GHz: 4.18dB 1GHz ~ 25GHz: 4.76dB
Spurious Emissions, Conducted - SR1
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 0.78dB
Output Power - SR1
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 1.13dB
Power Spectrum Density - SR1
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 1.15dB
Occupied Bandwidth - SR1
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 0.28%

7. TEST RESULT

7.1. Summary

Company Name: **Yuneec Technology Co., Limited**
FCC ID: **2ACS5-ST10C**
IC: **11554B-ST10C**
FCC Classification: **Digital Transmission System (DTS)**

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	RSS-247 [5.2]	6dB Bandwidth	≥ 500kHz	Conducted	Pass	Section 7.2
15.247(b)(3)	RSS-247 [5.4(4)]	Output Power	≤ 1Watt & EIRP ≤ 4Watt		Pass	Section 7.3
15.247(e)	RSS-247 [5.2]	Power Spectral Density	≤ 8dBm / 3kHz Band		Pass	Section 7.4
15.247(d)	RSS-247 [5.5]	Band Edge / Out-of-Band Emissions	≥ 20dBc(Peak)		Pass	Section 7.5
15.205 15.209	RSS-247 [5.5]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209	Radiated	Pass	Section 7.6 & 7.7
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	Line Conducted	N/A	Section 7.8

Notes:

1) All modes of operation and data rates were investigated. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst case emissions.
2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.

7.2. 6dB Bandwidth Measurement

7.2.1.Test Limit

The minimum 6dB bandwidth shall be at least 500 kHz.

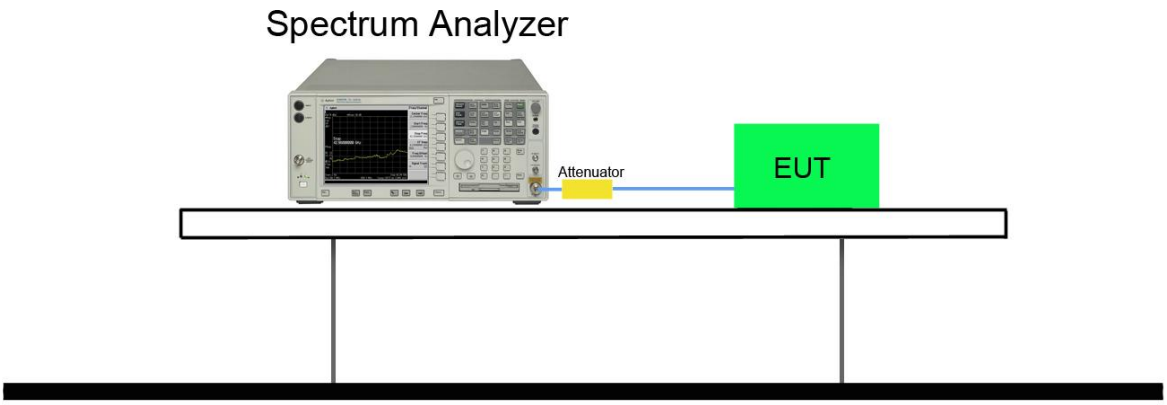
7.2.2.Test Procedure used

KDB 558074 D01v04 - Section 8.2 Option 2

7.2.3.Test Setting

1. The Spectrum's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. Set RBW = 100 kHz
3. VBW ≥ 3 × RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace was allowed to stabilize

7.2.4.Test Setup



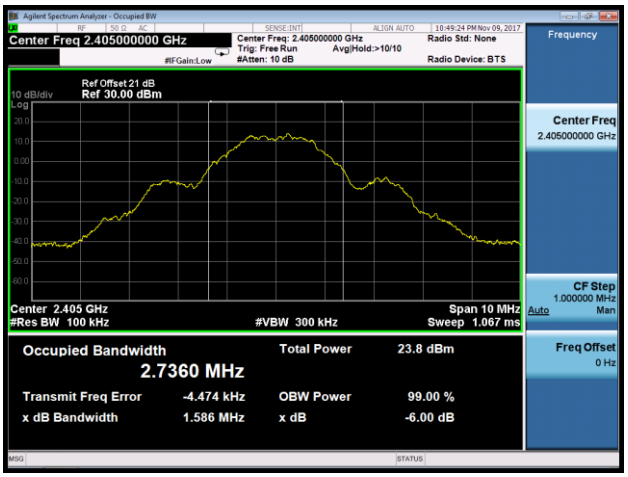
7.2.5.Test Result

Product	Personal Ground Station	Temperature	24°C
Test Engineer	Kevin Ker	Relative Humidity	59%
Test Site	SR1	Test Date	2017/11/09

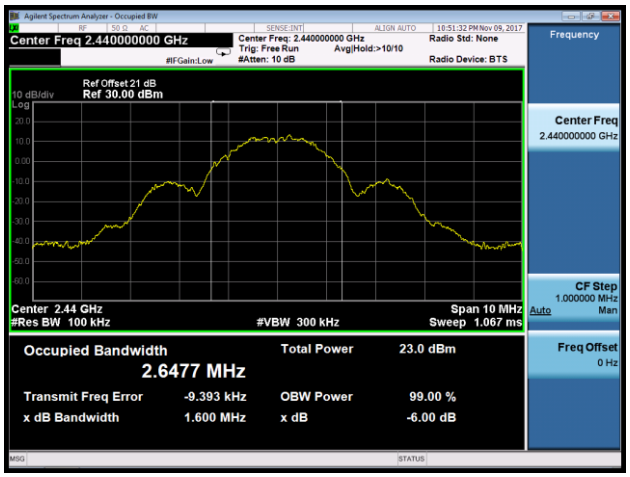
Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.15.4	O-QPSK	11	2405	1.59	≥ 0.5	Pass
802.15.4	O-QPSK	18	2440	1.60	≥ 0.5	Pass
802.15.4	O-QPSK	25	2475	1.62	≥ 0.5	Pass

802.15.4 6dB Bandwidth

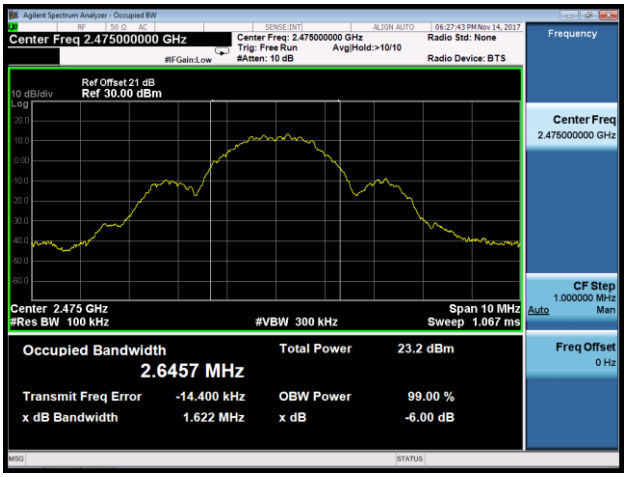
Channel 11 (2405MHz)



Channel 18 (2440MHz)



Channel 25 (2475MHz)



7.3. Output Power Measurement

7.3.1.Test Limit

The maximum output power shall be less 1 Watt (30dBm).

7.3.2.Test Procedure Used

KDB 558074 D01v04 - Section 9.1.3 PKPM1 Peak-reading power meter method

KDB 558074 D01v04 - Section 9.2.3.2 Method AVGPM-G

7.3.3.Test Setting

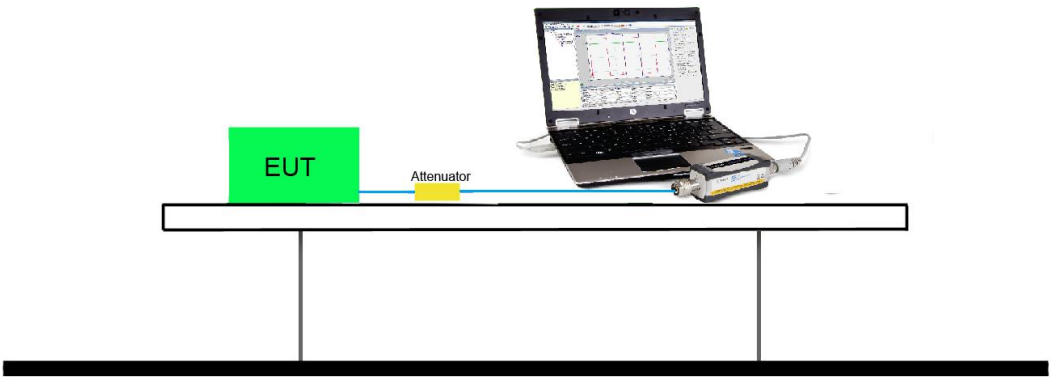
Method PKPM1 (Peak Power Measurement)

Peak power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The pulse sensor employs a VBW = 50MHz so this method was only used for signals whose DTS bandwidth was less than or equal to 50MHz.

Method AVGPM-G (Measurement using a gated RF average-reading power meter)

Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.

7.3.4.Test Setup



7.3.5.Test Result of Output Power

Product	Personal Ground Station	Temperature	24°C
Test Engineer	Kevin Ker	Relative Humidity	59%
Test Site	SR1	Test Date	2017/11/09
Test Item	Output Power (FCC & IC)		

Test Result of Peak Output Power

Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)	E.I.R.P (dBm)	Limit (dBm)	Result
802.15.4	O-QPSK	11	2405	17.96	≤ 30	19.18	≤ 36	Pass
802.15.4	O-QPSK	18	2440	17.53	≤ 30	18.75	≤ 36	Pass
802.15.4	O-QPSK	25	2475	17.54	≤ 30	18.76	≤ 36	Pass

Note: E.I.R.P (dBm) = Peak Output Power (dBm) + Antenna Gain (dBi).

Test Result of Average Output Power (Reporting Only)

Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	Average Output Power (dBm)	Limit (dBm)	E.I.R.P (dBm)	Limit (dBm)	Result
802.15.4	O-QPSK	11	2405	17.75	≤ 30	18.97	≤ 36	Pass
802.15.4	O-QPSK	18	2440	17.27	≤ 30	18.49	≤ 36	Pass
802.15.4	O-QPSK	25	2475	17.28	≤ 30	18.50	≤ 36	Pass

Note: E.I.R.P (dBm) = Average Output Power (dBm) + Antenna Gain (dBi).

7.4. Power Spectral Density Measurement

7.4.1.Test Limit

The maximum permissible power spectral density is 8dBm in any 3 kHz band.

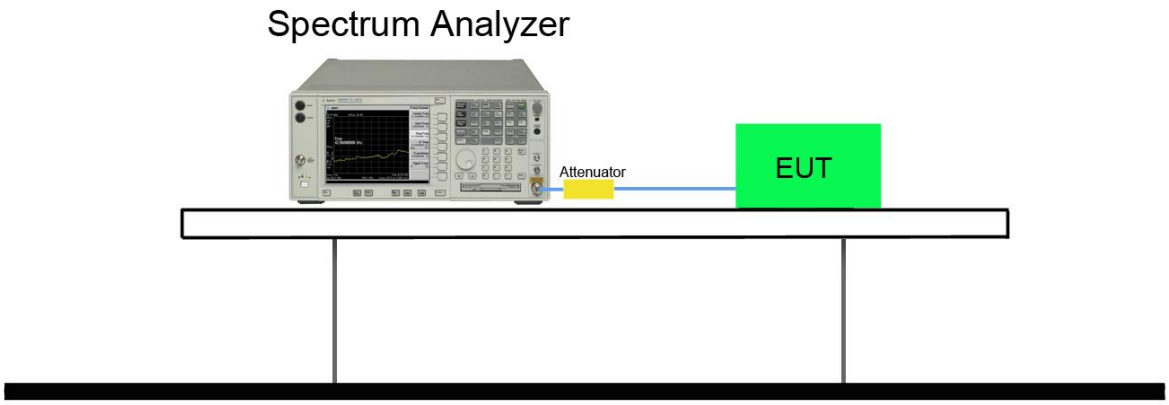
7.4.2.Test Procedure Used

KDB 558074 D01v04 - Section 10.2 Method PKPSD

7.4.3.Test Setting

1. Analyzer was set to the center frequency of the DTS channel under investigation
2. Span = 1.5 times the DTS channel bandwidth
3. RBW = 3kHz
4. VBW = 10kHz
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Trace was allowed to stabilize

7.4.4.Test Setup



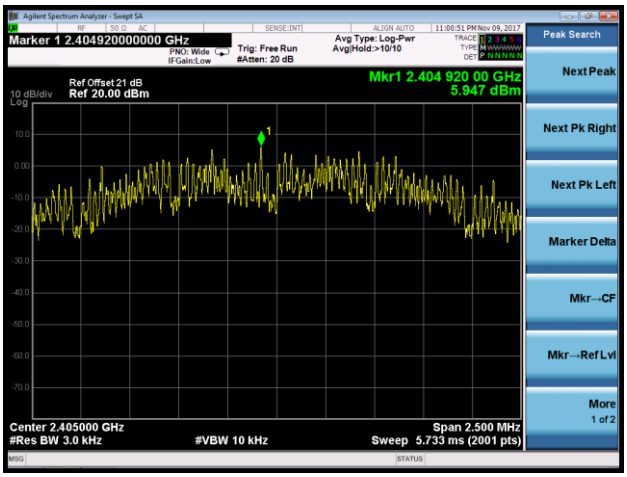
7.4.5.Test Result

Product	Personal Ground Station	Temperature	24°C
Test Engineer	Kevin Ker	Relative Humidity	59%
Test Site	SR1	Test Date	2017/11/09

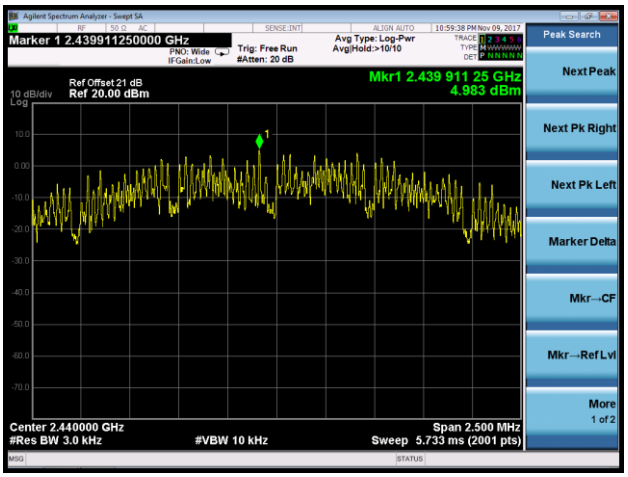
Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	Measured PSD (dBm / 3kHz)	Limit (dBm / 3kHz)	Result
802.15.4	O-QPSK	11	2405	5.95	≤ 8	Pass
802.15.4	O-QPSK	18	2440	4.98	≤ 8	Pass
802.15.4	O-QPSK	25	2475	6.13	≤ 8	Pass

802.15.4 Power Density

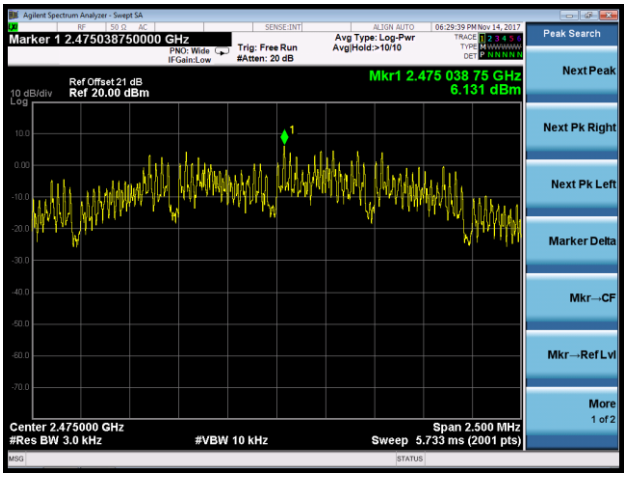
Channel 11 (2405MHz)



Channel 18 (2440MHz)



Channel 25 (2475MHz)



7.5. Conducted Band Edge and Out-of-Band Emissions

7.5.1.Test Limit

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100 kHz bandwidth per the PSD procedure.

7.5.2.Test Procedure Used

KDB 558074 D01v04 - Section 11.2 & Section 11.3

7.5.3.Test Settitng

1. Reference level measurement

(a) Set instrument center frequency to DTS channel center frequency

(b) Set the span to ≥ 1.5 times the DTS bandwidth

(c) Set the RBW = 100 kHz

(d) Set the VBW ≥ 3 x RBW

(e) Detector = peak

(f) Sweep time = auto couple

(g) Trace mode = max hold

(h) Allow trace to fully stabilize

2. Emission level measurement

(a) Set the center frequency and span to encompass frequency range to be measured

(b) RBW = 100kHz

(c) VBW = 300kHz

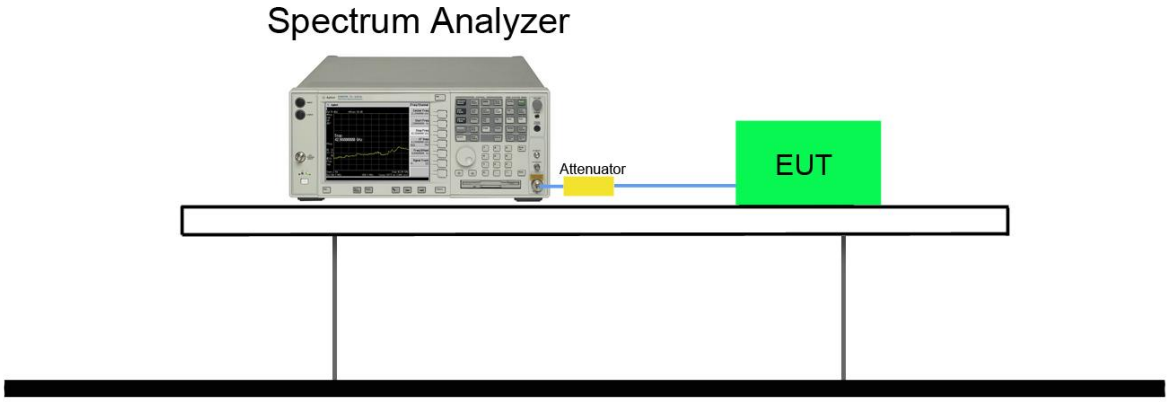
(d) Detector = Peak

(e) Trace mode = max hold

(f) Sweep time = auto couple

(g) The trace was allowed to stabilize

7.5.4.Test Setup



7.5.5.Test Result

Product	Personal Ground Station	Temperature	24°C
Test Engineer	Kevin Ker	Relative Humidity	59%
Test Site	SR1	Test Date	2017/11/09

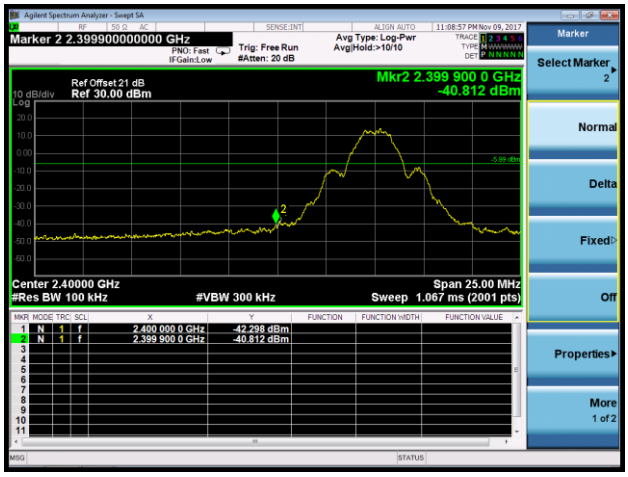
Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	Limit	Result
802.15.4	O-QPSK	11	2405	20dBc	Pass
802.15.4	O-QPSK	18	2440	20dBc	Pass
802.15.4	O-QPSK	25	2475	20dBc	Pass

802.15.4 Out-of-Band Emissions

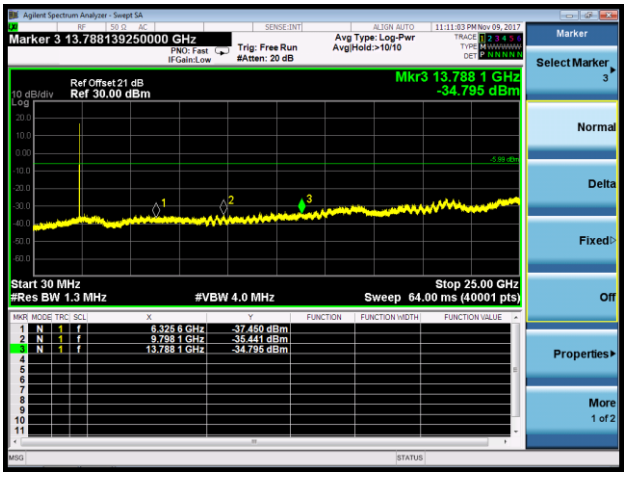
Channel 11 (2405MHz)

100kHz PSD reference Level

Low Band Edge



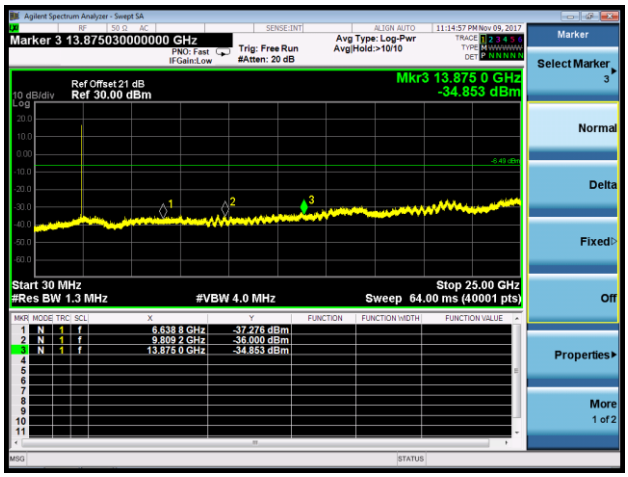
Spurious Emission



Channel 18 (2440MHz)

100kHz PSD reference Level

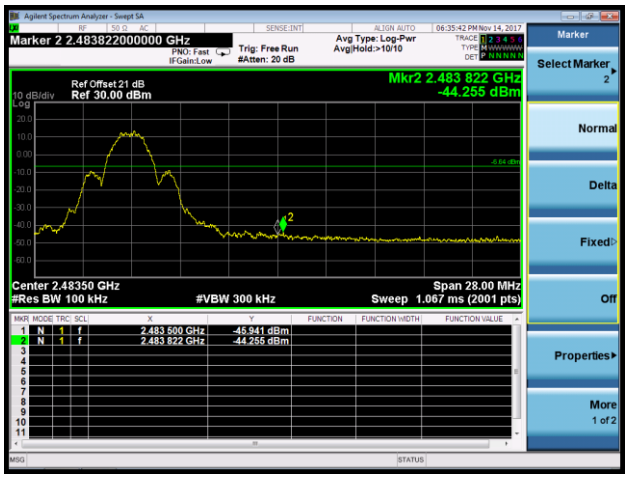
Spurious Emission



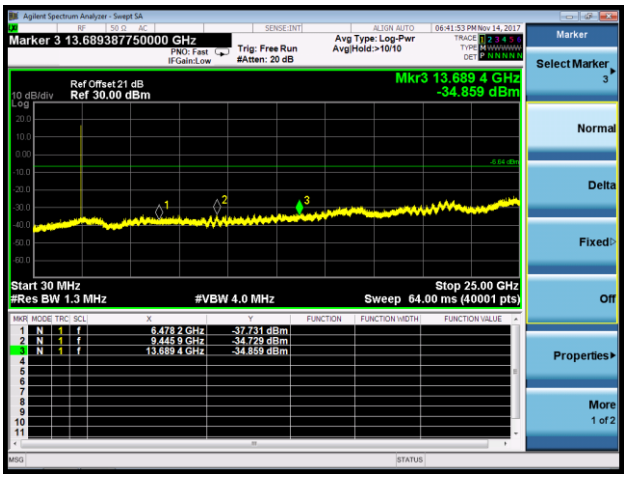
Channel 25 (2475MHz)

100kHz PSD reference Level

High Band Edge



Spurious Emission



7.6. Radiated Spurious Emission Measurement

7.6.1.Test Limit

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table per Section 15.209.

FCC Part 15 Subpart C Paragraph 15.209		
Frequency [MHz]	Field Strength [uV/m]	Measured Distance [Meters]
0.009 – 0.490	2400/F (kHz)	300
0.490 – 1.705	24000/F (kHz)	30
1.705 - 30	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

7.6.2.Test Procedure Used

KDB 558074 D01v04 – Section 12.2.3 (quasi-peak measurements)

KDB 558074 D01v04 – Section 12.2.4 (peak power measurements)

KDB 558074 D01v04 – Section 12.2.5 (average power measurements)

7.6.3.Test Setting

Peak Field Strength Measurements per Section 12.2.4 of KDB 558074 D01v04

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = as specified in Table 1
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple

6. Trace mode = max hold
7. Trace was allowed to stabilize

Table 1 - RBW as a function of frequency

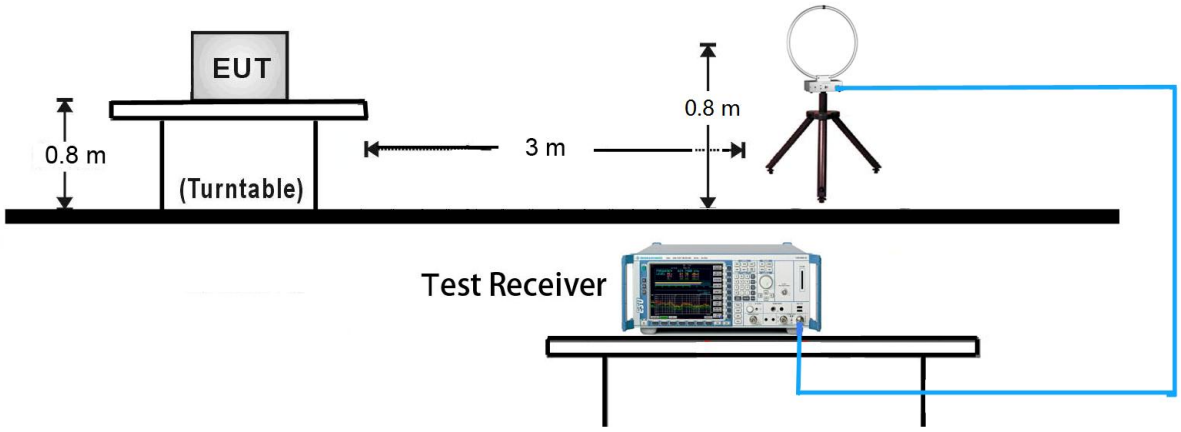
Frequency	RBW
9 ~ 150 kHz	200 ~ 300 Hz
0.15 ~ 30 MHz	9 ~ 10 kHz
30 ~ 1000 MHz	100 ~ 120 kHz
> 1000 MHz	1 MHz

Average Field Strength Measurements per Section 12.2.5.3 of KDB 558074 D01v04

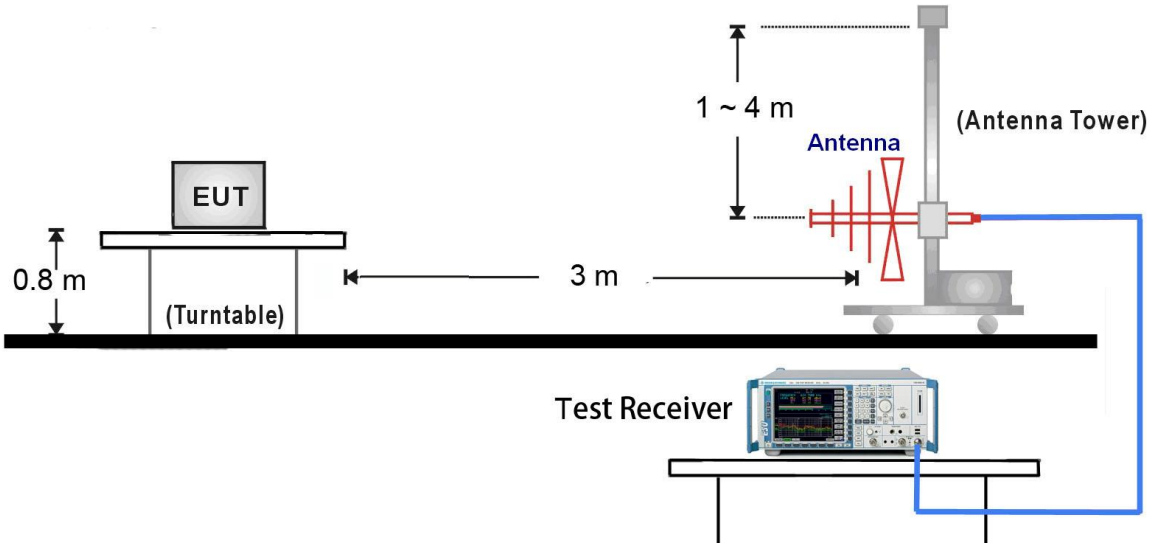
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW ≥ 1/T
4. De As an alternative, the instrument may be set to linear detector mode. Ensure that video filtering is applied in linear voltage domain (rather than in a log or dB domain). Some instruments require linear display mode in order to accomplish this. Others have a setting for Average-VBW Type, which can be set to “Voltage” regardless of the display mode
5. Detector = Peak
6. Sweep time = auto
7. Trace mode = max hold
8. Allow max hold to run for at least 50 times (1/duty cycle) traces

7.6.4.Test Setup

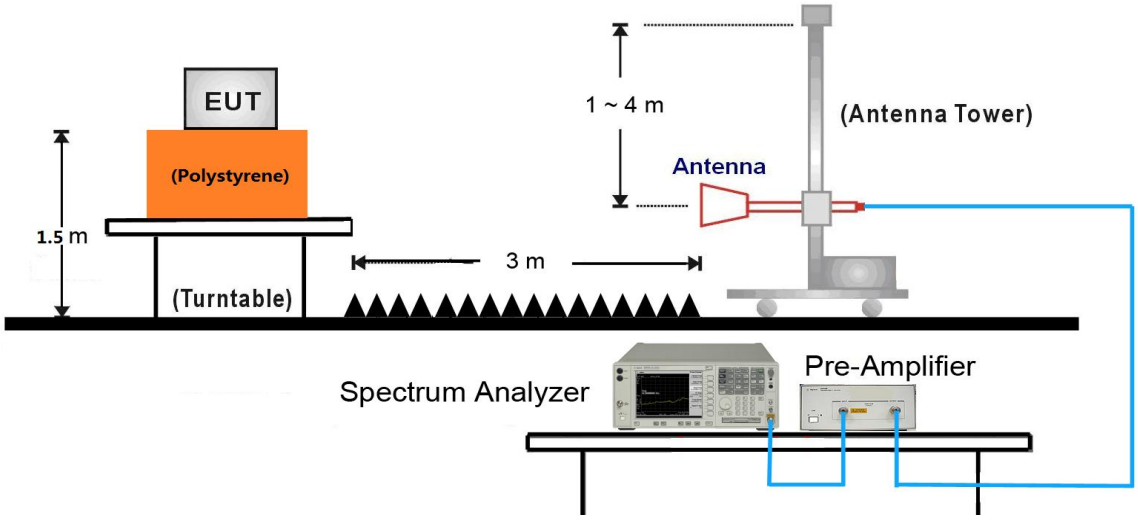
9kHz ~ 30MHz Test Setup:



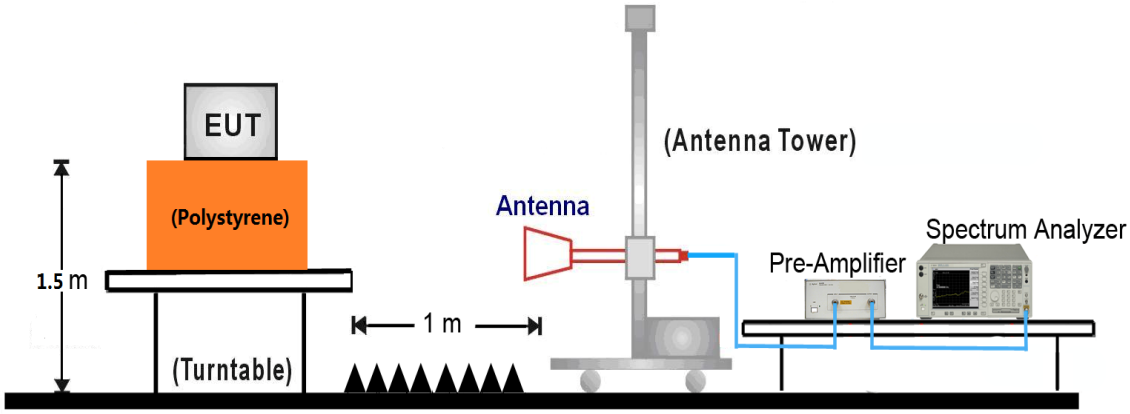
30MHz ~ 1GHz Test Setup:



1GHz ~ 18GHz Test Setup:



18GHz ~25GHz Test Setup:



7.6.5.Test Result

Test Mode:	802.15.4	Test Site:	AC1
Test Channel:	11	Test Engineer:	Kevin Ker
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
	4808.0	35.0	3.7	38.7	74.0	-35.3	Peak	Horizontal
	5411.5	32.9	4.0	36.9	74.0	-37.1	Peak	Horizontal
*	7213.5	30.8	12.1	42.9	90.6	-47.7	Peak	Horizontal
*	14022.0	25.1	22.7	47.8	90.6	-42.8	Peak	Horizontal
	4808.0	35.7	3.7	39.4	74.0	-34.6	Peak	Vertical
	5445.5	31.7	4.1	35.8	74.0	-38.2	Peak	Vertical
*	7213.5	30.0	12.1	42.1	90.6	-48.5	Peak	Vertical
*	14175.0	24.6	23.1	47.7	90.6	-42.9	Peak	Vertical

Note 1: "*" is not in restricted band, its limit is 20dBc of the fundamental emission level (110.6dBμV/m) or 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)

Test Mode:	802.15.4	Test Site:	AC1
Test Channel:	18	Test Engineer:	Kevin Ker
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
	4876.0	42.2	3.7	45.9	74.0	-28.1	Peak	Horizontal
	7315.5	31.8	12.3	44.1	74.0	-29.9	Peak	Horizontal
*	9763.5	32.2	14.9	47.1	90.6	-43.5	Peak	Horizontal
*	13920.0	26.3	22.4	48.7	90.6	-41.9	Peak	Horizontal
	4876.0	43.7	3.7	47.4	74.0	-26.6	Peak	Vertical
	8046.5	31.2	12.5	43.7	74.0	-30.3	Peak	Vertical
*	9755.0	38.2	14.8	53.0	90.6	-37.6	Peak	Vertical
*	13911.5	24.7	22.4	47.1	90.6	-43.5	Peak	Vertical

Note 1: "*" is not in restricted band, its limit is 20dBc of the fundamental emission level (110.6dBμV/m) or 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)

Test Mode:	802.15.4	Test Site:	AC1
Test Channel:	25	Test Engineer:	Kevin Ker
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
	4952.5	40.3	3.7	44.0	74.0	-30.0	Peak	Horizontal
	7426.0	38.5	12.7	51.2	74.0	-22.8	Peak	Horizontal
	7426.3	33.5	12.7	46.2	54.0	-7.8	Average	Horizontal
*	9899.5	37.7	15.4	53.1	90.6	-37.5	Peak	Horizontal
*	13784.0	25.5	22.1	47.6	90.6	-43.0	Peak	Horizontal
	4952.5	43.3	3.7	47.0	74.0	-27.0	Peak	Vertical
	7426.0	34.3	12.7	47.0	74.0	-27.0	Peak	Vertical
*	9899.5	36.2	15.4	51.6	90.6	-39.0	Peak	Vertical
*	13979.5	25.2	22.6	47.8	90.6	-42.8	Peak	Vertical

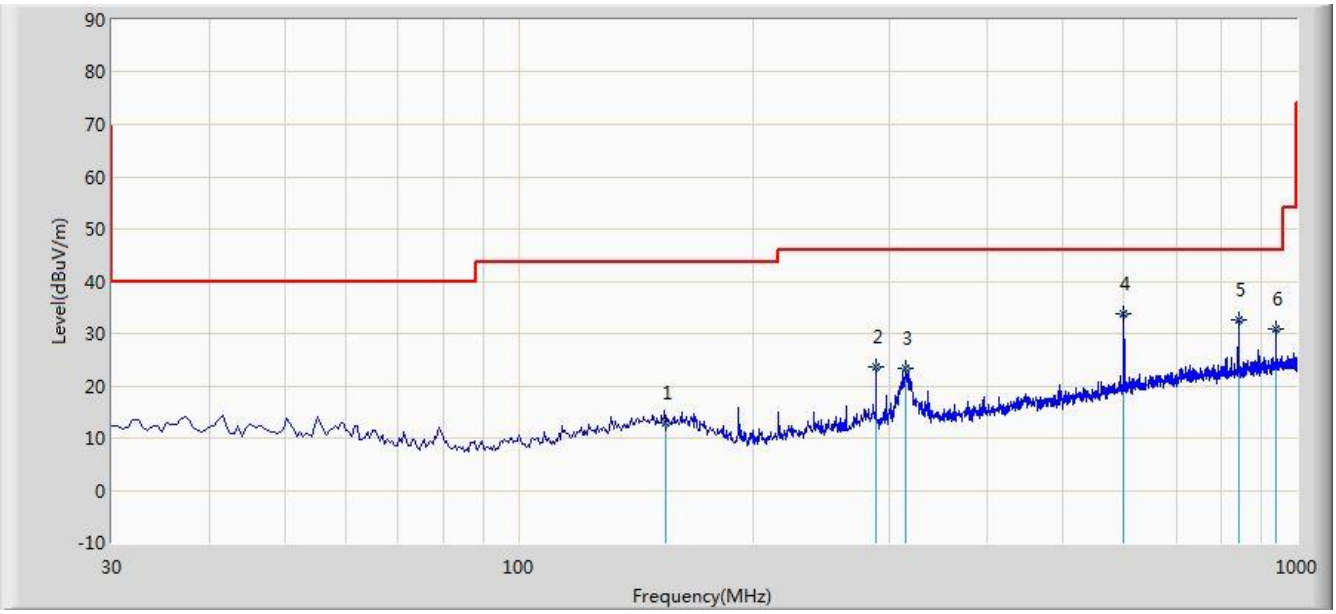
Note 1: "*" is not in restricted band, its limit is 20dBc of the fundamental emission level (110.6dBμV/m) or 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)

The worst case of Radiated Emission below 1GHz:

Site: AC1	Time: 2017/11/21 - 18:35
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: VULB9162_0.03-8GHz	Polarity: Horizontal
EUT: Personal Ground Station	Power: By Battery
Worse Case Mode: Transmit at Channel 2405MHz by 802.15.4	



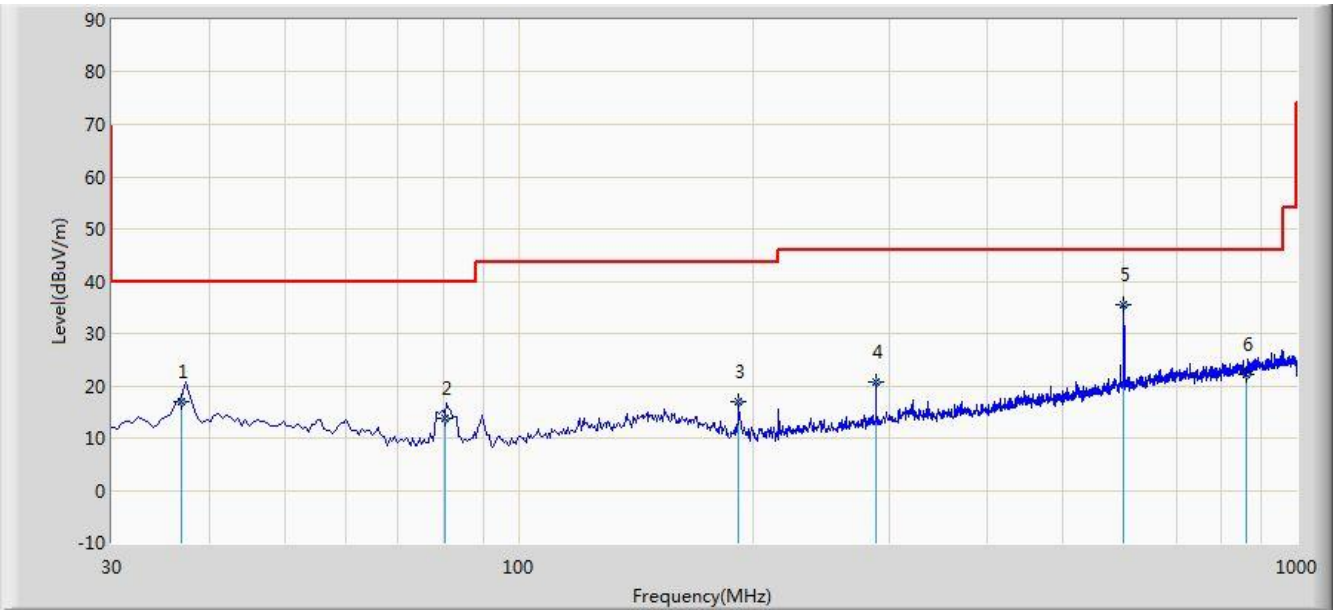
No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			154.645	12.919	3.159	-30.581	43.500	9.760	QP
2			288.020	23.602	9.095	-22.398	46.000	14.507	QP
3			314.210	23.223	8.106	-22.777	46.000	15.117	QP
4		*	599.875	33.867	13.547	-12.133	46.000	20.320	QP
5			841.405	32.686	8.906	-13.314	46.000	23.780	QP
6			940.830	30.761	6.038	-15.239	46.000	24.723	QP

Note 1: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Note 2: The test trace is same as the ambient noise and the amplitude of the emissions are attenuated more than 20dB below the permissible (the test frequency range: 9kHz ~ 30MHz, 18GHz ~ 25GHz), therefore no data appear in the report.

Site: AC1	Time: 2017/11/21 - 18:41
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: VULB9162_0.03-8GHz	Polarity: Vertical
EUT: Personal Ground Station	Power: By Battery
Worse Case Mode: Transmit at Channel 2405MHz by 802.15.4	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			36.790	16.915	3.644	-23.085	40.000	13.271	QP
2			80.440	13.889	4.385	-26.111	40.000	9.504	QP
3			191.990	16.915	4.881	-26.585	43.500	12.034	QP
4			288.020	20.589	6.082	-25.411	46.000	14.507	QP
5		*	599.875	35.431	15.111	-10.569	46.000	20.320	QP
6			861.775	22.299	-1.778	-23.701	46.000	24.077	QP

Note 1: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

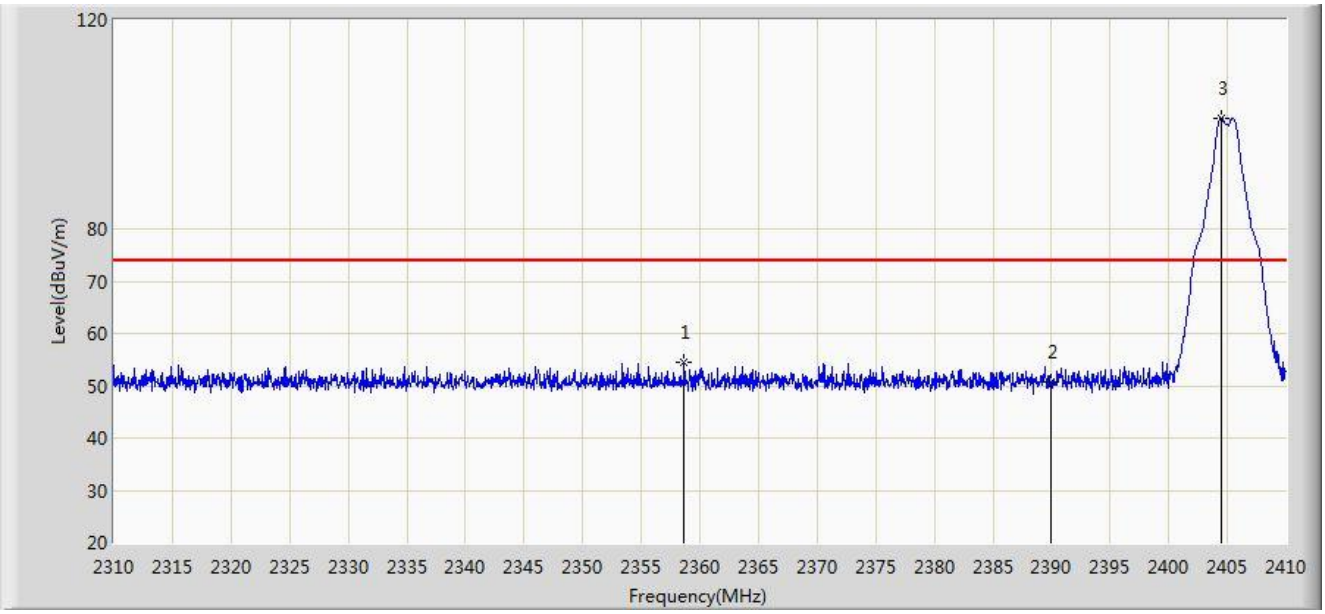
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Note 2: The test trace is same as the ambient noise and the amplitude of the emissions are attenuated more than 20dB below the permissible (the test frequency range: 9kHz ~ 30MHz, 18GHz ~ 25GHz), therefore no data appear in the report.

7.7. Radiated Restricted Band Edge Measurement

7.7.1.Test Result

Site: AC1	Time: 2017/11/20 - 18:38
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Personal Ground Station	Power: By Battery
Test Mode: Transmit at Channel 2405MHz by 802.15.4	

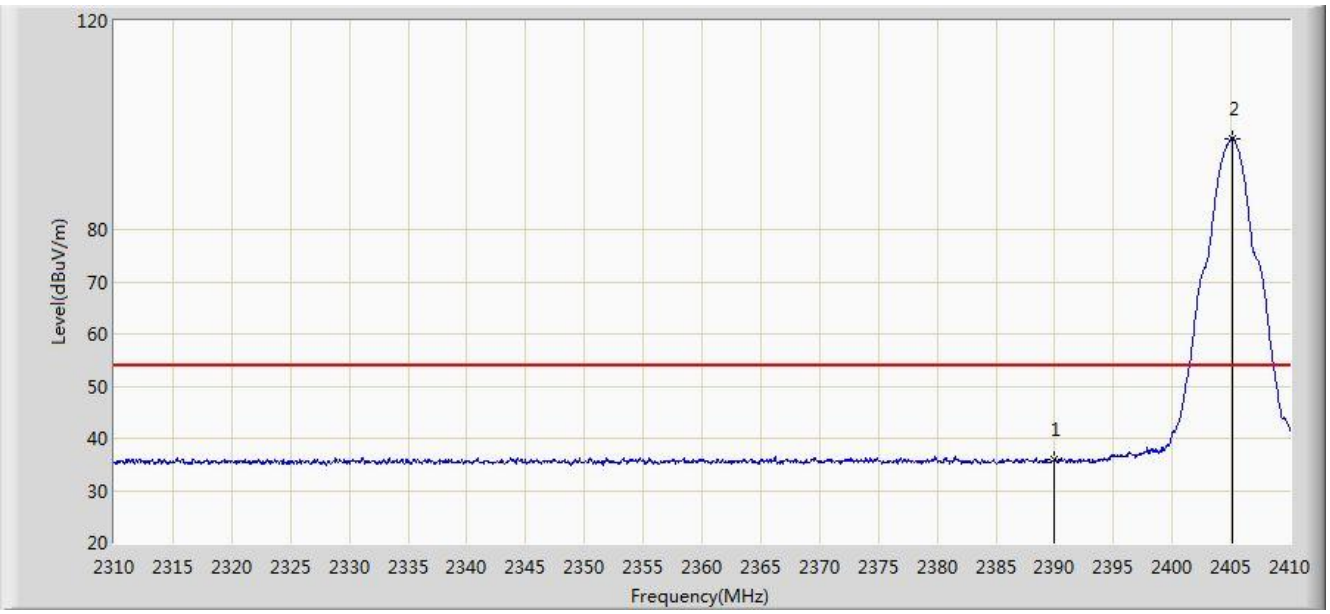


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2358.650	54.636	22.036	-19.364	74.000	32.600	PK
2			2390.000	50.795	18.241	-23.205	74.000	32.554	PK
3		*	2404.450	101.144	68.609	N/A	N/A	32.535	PK

Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2017/11/20 - 18:39
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Personal Ground Station	Power: By Battery
Test Mode: Transmit at Channel 2405MHz by 802.15.4	

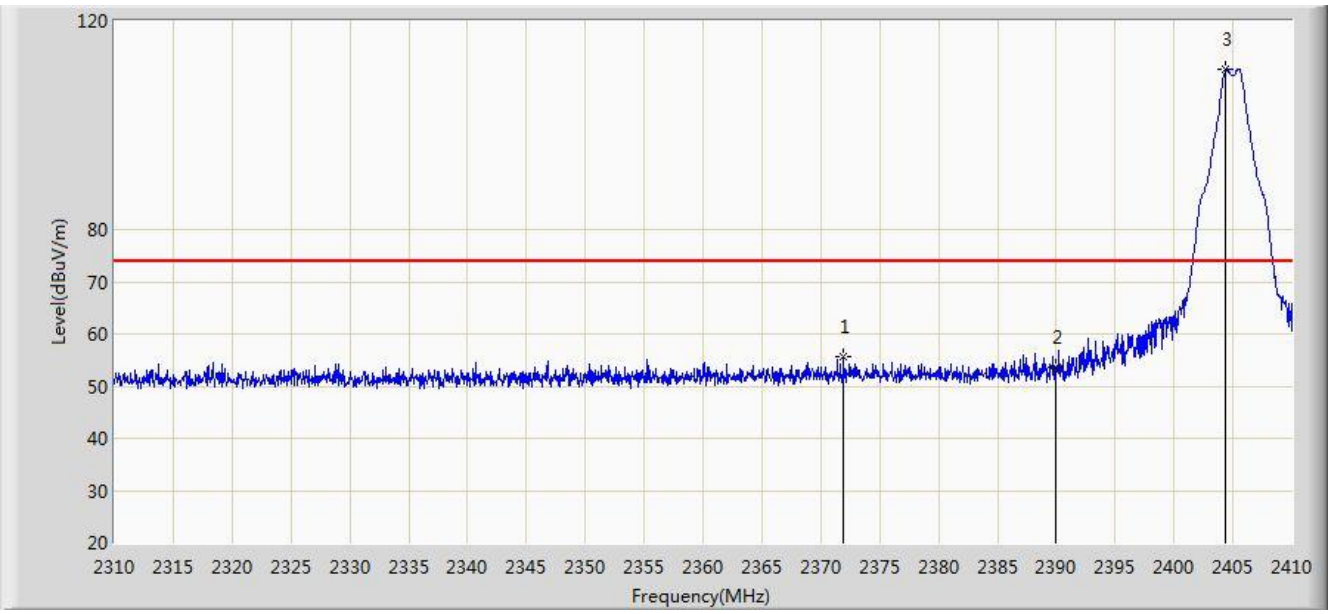


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2390.000	35.818	3.264	-18.182	54.000	32.554	AV
2		*	2405.150	97.502	64.968	N/A	N/A	32.534	AV

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2017/11/20 - 18:41
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Personal Ground Station	Power: By Battery
Test Mode: Transmit at Channel 2405MHz by 802.15.4	

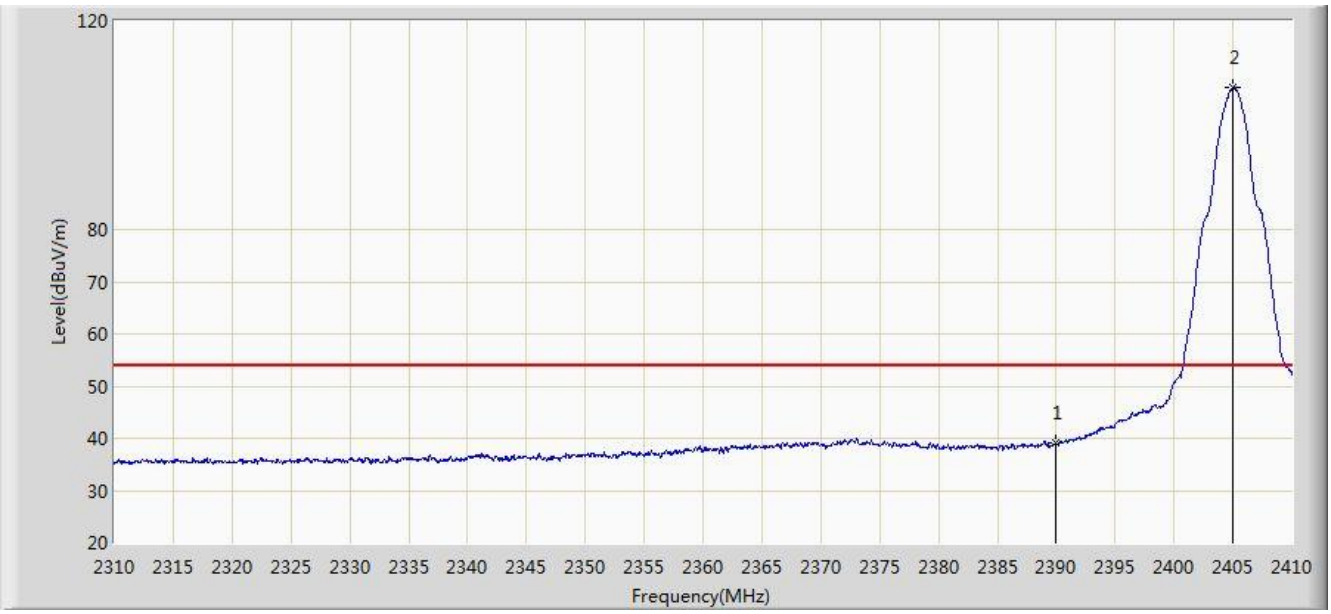


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2388.250	56.349	23.792	-17.651	74.000	32.557	PK
2			2390.000	53.530	20.976	-20.470	74.000	32.554	PK
3		*	2404.350	110.595	78.060	N/A	N/A	32.535	PK

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2017/11/20 - 18:43
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Personal Ground Station	Power: By Battery
Test Mode: Transmit at Channel 2405MHz by 802.15.4	

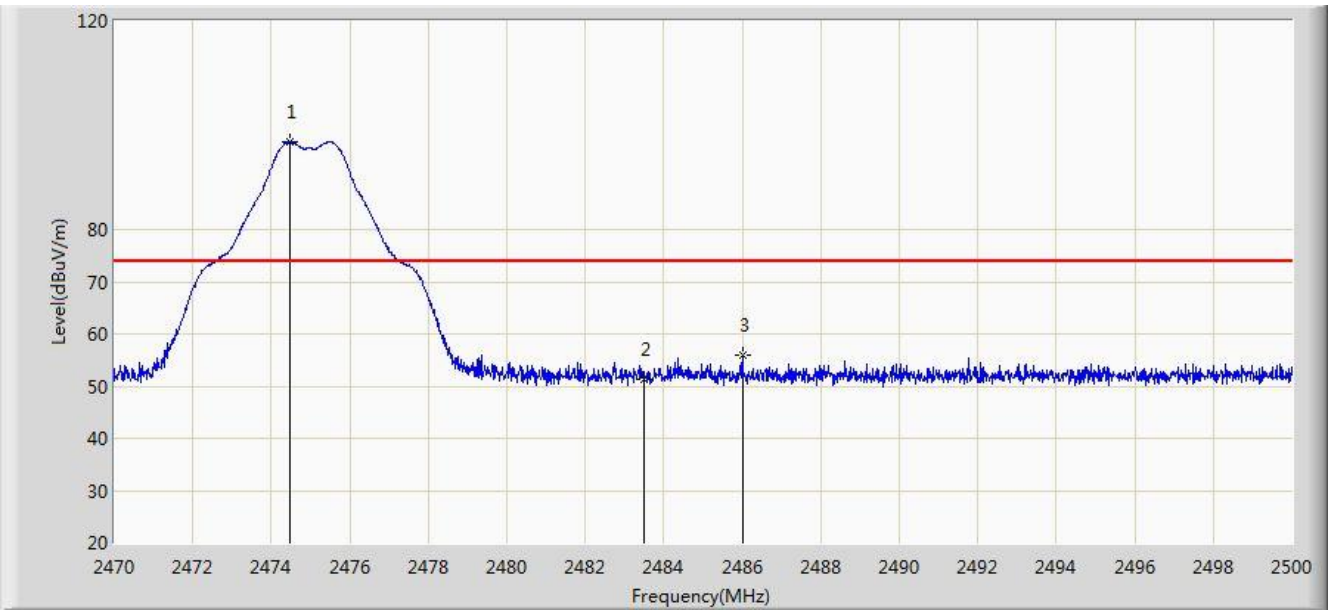


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2390.000	39.069	6.515	-14.931	54.000	32.554	AV
2		*	2405.150	107.266	74.732	N/A	N/A	32.534	AV

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2017/11/20 - 18:45
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Personal Ground Station	Power: By Battery
Test Mode: Transmit at Channel 2475MHz by 802.15.4	

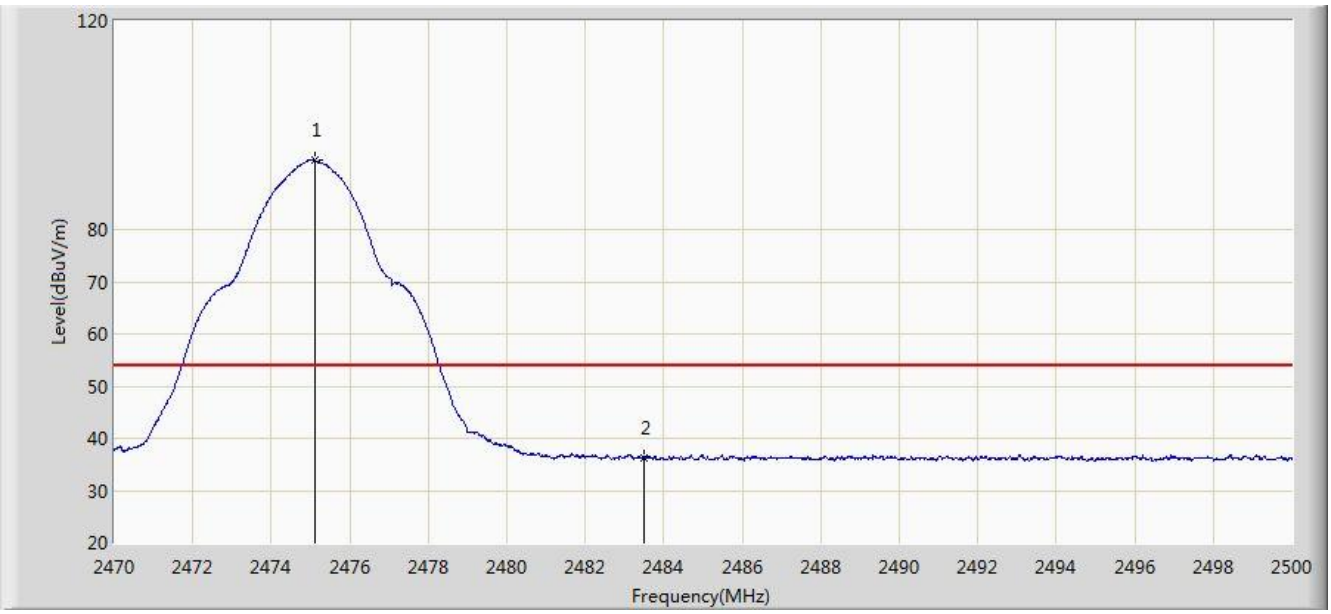


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2475.490	96.787	64.231	N/A	N/A	32.557	PK
2			2483.500	51.256	18.675	-22.744	74.000	32.580	PK
3			2491.750	55.399	22.794	-18.601	74.000	32.605	PK

Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2017/11/20 - 18:55
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Personal Ground Station	Power: By Battery
Test Mode: Transmit at Channel 2475MHz by 802.15.4	

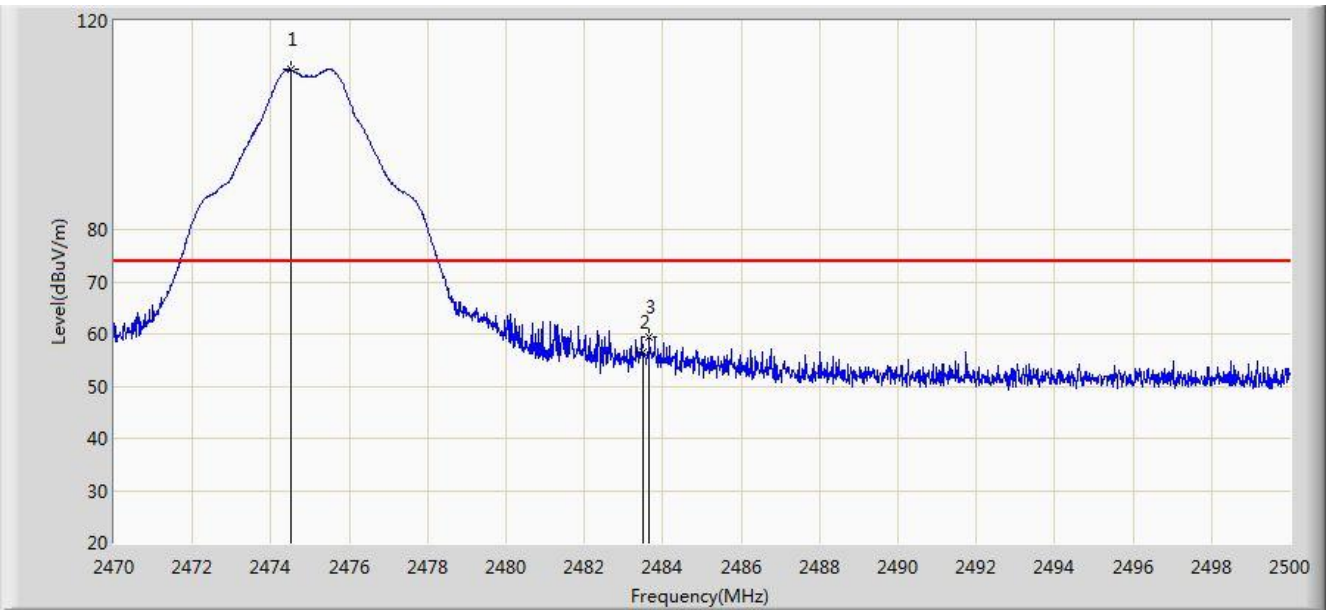


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2475.025	93.274	60.719	N/A	N/A	32.555	AV
2			2483.500	36.178	3.597	-17.822	54.000	32.580	AV

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2017/11/20 - 18:56
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Personal Ground Station	Power: By Battery
Test Mode: Transmit at Channel 2475MHz by 802.15.4	

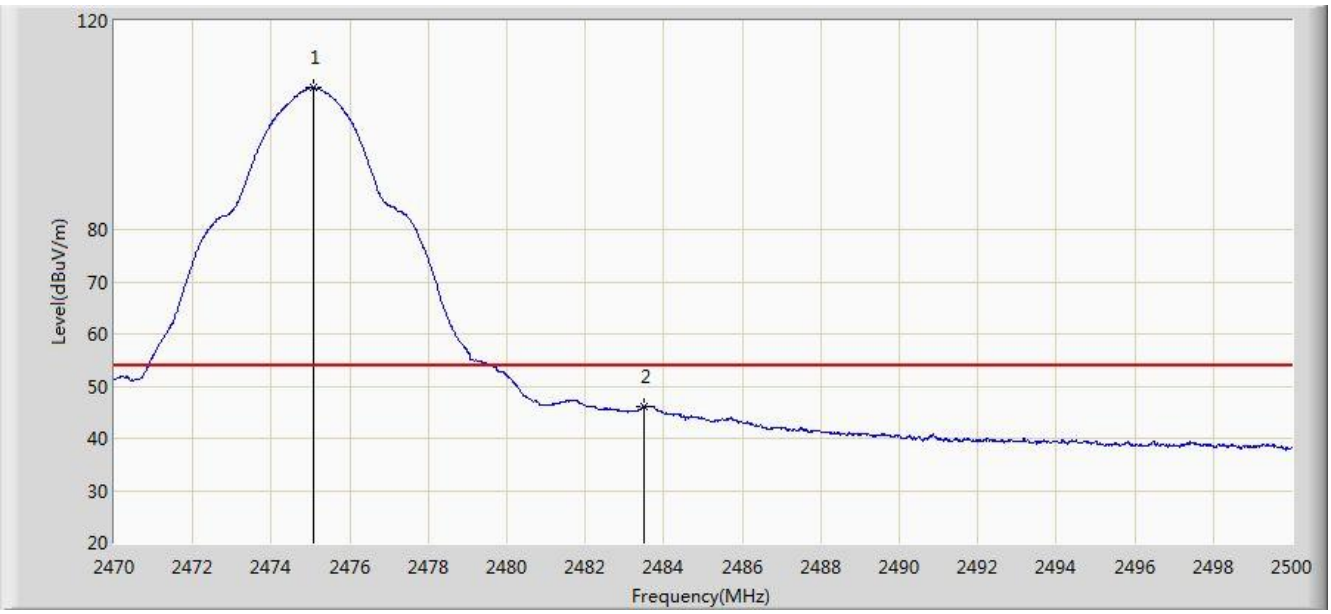


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2475.535	110.624	78.067	N/A	N/A	32.557	PK
2			2483.500	56.380	23.799	-17.620	74.000	32.580	PK
3			2483.800	59.321	26.740	-14.679	74.000	32.582	PK

Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2017/11/20 - 18:57
Limit: FCC_Part15.209_RE(3m)	Engineer: Kevin Ker
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Personal Ground Station	Power: By Battery
Test Mode: Transmit at Channel 2475MHz by 802.15.4	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2475.070	107.232	74.677	N/A	N/A	32.555	AV
2			2483.500	46.066	13.485	-7.934	54.000	32.580	AV

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

7.1. AC Conducted Emissions Measurement

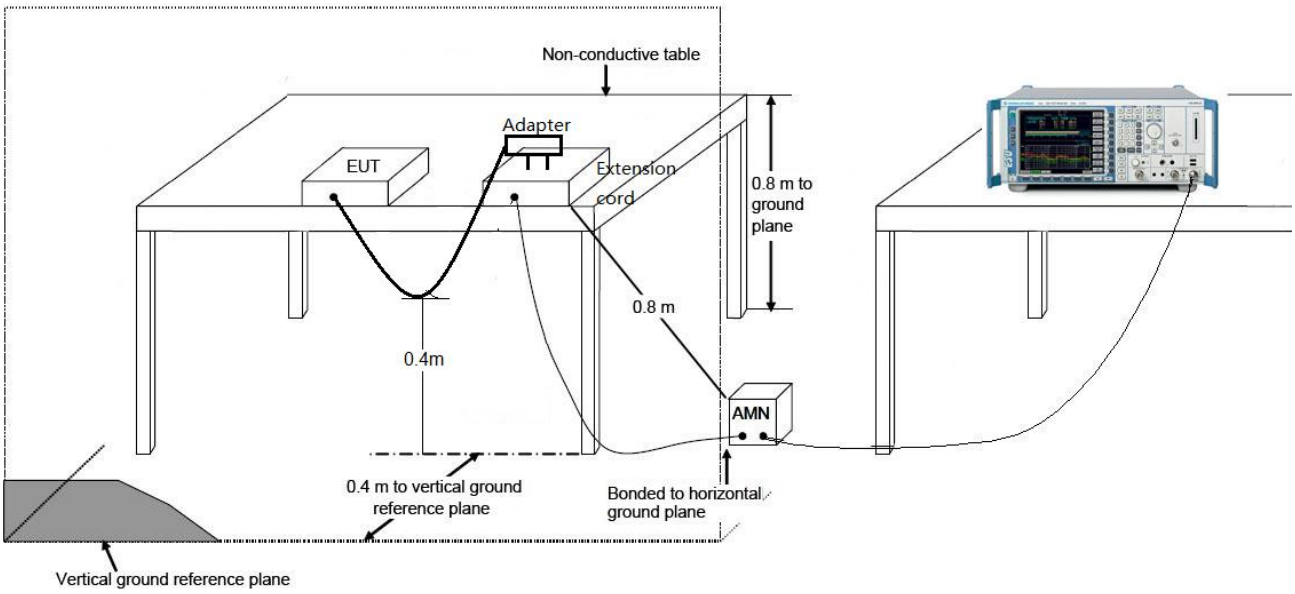
7.1.1.Test Limit

FCC Part 15 Subpart C Paragraph 15.207 Limits		
Frequency (MHz)	QP (dBuV)	AV (dBuV)
0.15 - 0.50	66 - 56	56 – 46
0.50 - 5.0	56	46
5.0 - 30	60	50

Note 1: The lower limit shall apply at the transition frequencies.

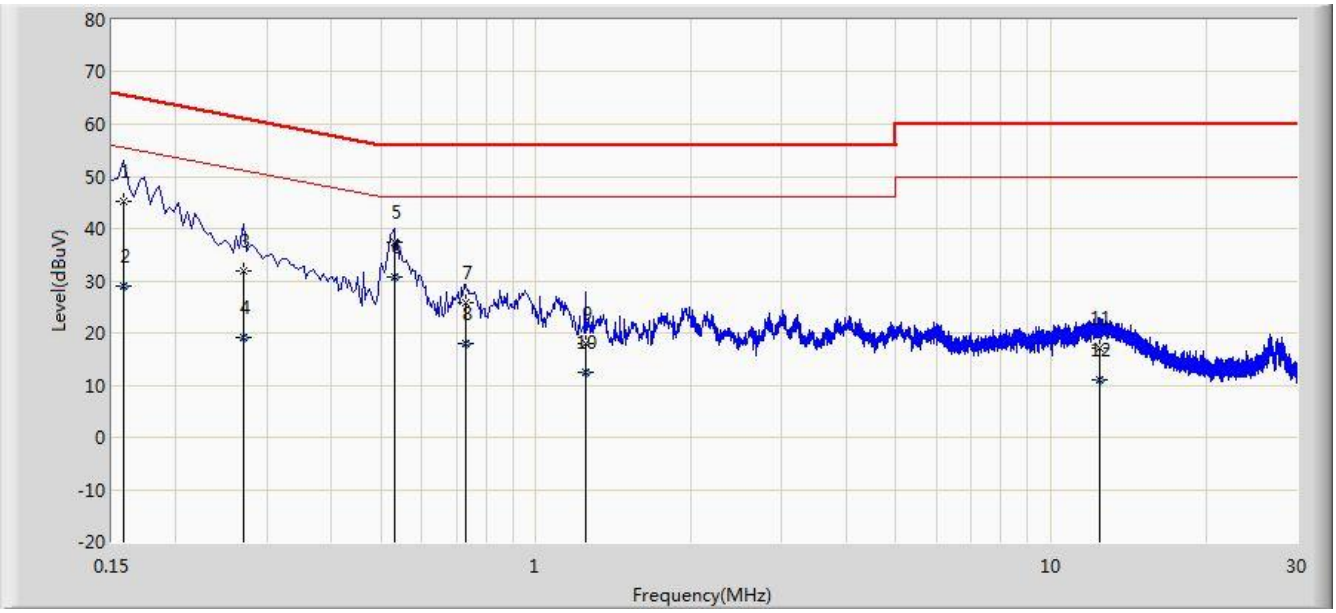
Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

7.1.2.Test Setup



7.1.3.Test Limit

Site: SR2	Time: 2017/11/24 - 15:44
Limit: FCC_Part15.207_CE_AC Power	Engineer: Kevin Ker
Probe: ENV216_101683_Filter On	Polarity: Line
EUT: Personal Ground Station	Power: AC 120V/60Hz
Worst Case Mode: Transmit at Channel 2440MHz by 802.15.4	

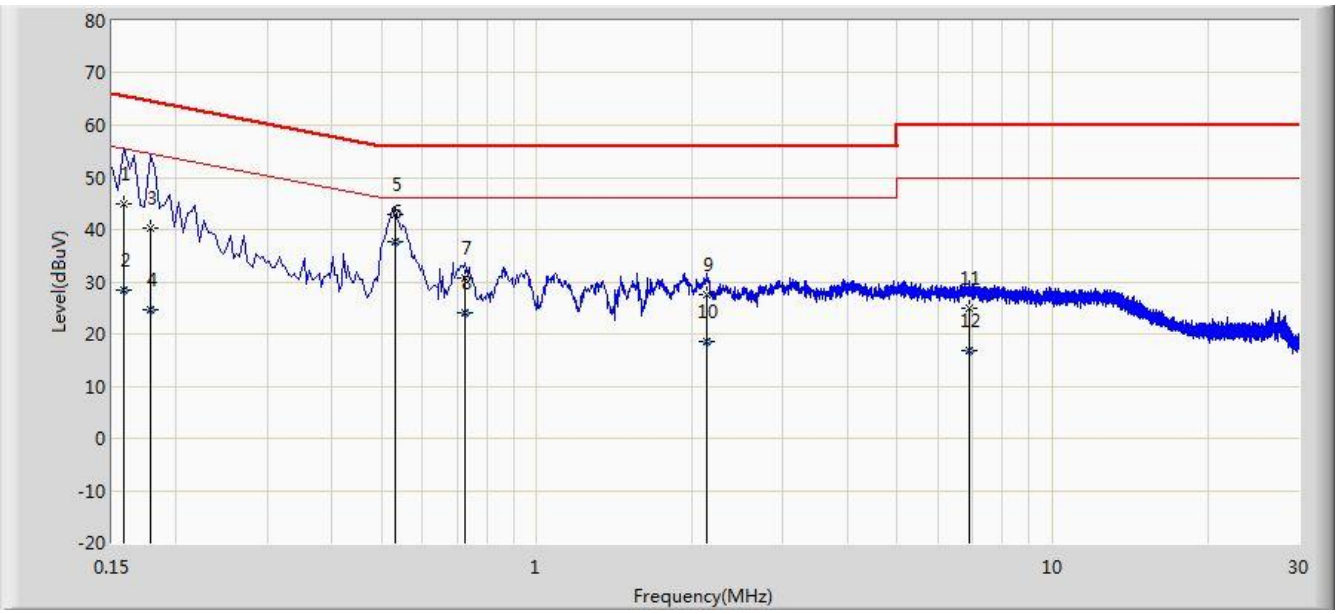


No	Flag	Mark	Frequency (MHz)	Measure Level (DBUV)	Reading Level (DBUV)	Over Limit (dB)	Limit (DBUV)	Factor (dB)	Type
1			0.158	45.281	34.970	-20.287	65.568	10.311	QP
2			0.158	28.928	18.617	-26.641	55.568	10.311	AV
3			0.270	31.954	21.974	-29.163	61.118	9.980	QP
4			0.270	19.110	9.130	-32.008	51.118	9.980	AV
5			0.530	37.499	27.348	-18.501	56.000	10.151	QP
6		*	0.530	30.816	20.665	-15.184	46.000	10.151	AV
7			0.730	25.828	15.780	-30.172	56.000	10.048	QP
8			0.730	18.076	8.028	-27.924	46.000	10.048	AV
9			1.246	17.945	8.045	-38.055	56.000	9.900	QP
10			1.246	12.343	2.443	-33.657	46.000	9.900	AV
11			12.466	16.959	6.890	-43.041	60.000	10.069	QP
12			12.466	10.970	0.902	-39.030	50.000	10.069	AV

Note: Measure Level (dBμV) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + LISN Factor (dB)

Site: SR2	Time: 2017/11/24 - 15:48
Limit: FCC_Part15.207_CE_AC Power	Engineer: Kevin Ker
Probe: ENV216_101683_Filter On	Polarity: Neutral
EUT: Personal Ground Station	Power: AC 120V/60Hz
Worst Case Mode: Transmit at Channel 2440MHz by 802.15.4	



No	Flag	Mark	Frequency (MHz)	Measure Level (DBUV)	Reading Level (DBUV)	Over Limit (dB)	Limit (DBUV)	Factor (dB)	Type
1			0.158	44.801	34.511	-20.767	65.568	10.290	QP
2			0.158	28.455	18.165	-27.113	55.568	10.290	AV
3			0.178	40.358	30.309	-24.220	64.578	10.049	QP
4			0.178	24.617	14.567	-29.962	54.578	10.049	AV
5			0.530	42.997	32.827	-13.003	56.000	10.169	QP
6		*	0.530	37.746	27.577	-8.254	46.000	10.169	AV
7			0.726	30.693	20.633	-25.307	56.000	10.060	QP
8			0.726	23.942	13.882	-22.058	46.000	10.060	AV
9			2.142	27.486	17.616	-28.514	56.000	9.870	QP
10			2.142	18.559	8.689	-27.441	46.000	9.870	AV
11			6.878	24.865	14.698	-35.135	60.000	10.167	QP
12			6.878	16.898	6.731	-33.102	50.000	10.167	AV

Note: Measure Level (dBμV) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + LISN Factor (dB)

8. CONCLUSION

The data collected relate only the item(s) tested and show that the **Personal Ground Station FCC ID: 2ACS5-ST10C** is in compliance with Part 15C of the FCC Rules and Part ISED Rules.

The End